# Chapter 19
# Corrosion Mitigation Considerations

## 19-1. General

*a.* The intent of this chapter is to supplement specific recommendations on corrosion control made in the preceding chapters.

*b.* Corrosion is a problem because of the ease with which it takes place on low-cost construction metals. The requirements for corrosion are the presence of a conducting fluid on a metal (or metals in intimate contact) and a flow of DC current. The presence of corrosion stimulators, such as oxygen or chlorides, contribute to a more rapid attack.

## 19-2. Design Considerations

*a. General.* To control corrosion, it is necessary to eliminate one or more of the above-mentioned requirements for corrosion. The following considerations suggest ways to exclude the conducting fluids from metals, suppress or halt the flow of DC current, and control corrosion stimulators.

*b. Goal = least cost programmed life.* As prices of labor and materials change and information on the performance of materials becomes available, past practice should be reviewed to determine if the goal is being achieved. For example, bare steel with an appropriate corrosion allowance may provide programmed life at lower cost than a coated structure.

*c. Environment.* It is sometimes useful to consider the possibility of altering the environment in which the equipment will be placed. The cost of protecting equipment from its environment can be changed significantly. For example, consider whether the equipment can be placed indoors rather than outdoors. Once the environment is set, proceed to select appropriate materials to withstand the environment or means of excluding fluids from a metallic structure, such as coatings.

*d. Design geometry.* Outdoor equipment in particular should avoid designs which allow water to be trapped or include sharp edges, crevices, numerous bolts, etc., which make coating application difficult. Similarly, places inside the powerhouse may require extra attention such as in water and sewage treatment rooms.

*e. Material selection.* In general, the Corps of Engineers engineering manuals and guide specifications provide conservative advice. The environment for some power plants (weather, water quality, etc.) may be more severe or less severe to such a degree that deviation from established guides may be warranted and should be documented in design memoranda. Also, the consequences of placing dissimilar metals in contact where moisture can be present should be evaluated. An alternative may be the use of nonmetallic materials.

*f. Protecting metals.* Methods of protection for various environments are indicated below. Actual choices should consider the aggressiveness of the environment (e.g., water analysis, soil resistivity).

(1) Immersed. This method includes structures immersed in water and the interior of water piping systems. The choices include corrosion resistant metals, metallic and nonmetallic coatings, dielectric isolators between dissimilar metals, and cathodic protection. Closed systems may also employ chemical treatment.

(2) Underground/embedded. The choices for underground are the same as for immersed described previously. Embedded structural metals normally do not require protection, except for aluminum or at the point of emergence from concrete.

(3) Atmospheric. The choice is usually made between corrosion-resistant metals and alloys or the use of coatings to protect ferrous materials in exterior exposures. Similar choices are used for interior exposures, dehumidification, and insulation.

*g. Galvanic couples.* Where galvanic coupling of dissimilar metals is expected to cause corrosion problems, the choices for prevention include dielectric isolation, coating of both metals, or cathodic protection. Unintentional galvanic couples such as ferrous underground or immersed piping, which is metallically connected to the copper station ground mat or coated steel piping adjacent to stainless steel tracks in an intake gate slot, will also create problems. In these latter cases, the relative area of noble metal is high due to the coating on the steel, and pitting can be rapid.

*h. Future maintenance.* Give consideration to how corrosion damage may be further retarded by renewing coatings, anodes, components, etc.

*i. Safety and critical items.* Items which involve life safety and require regular inspection (e.g., pressure vessels, hoist cables, etc.) should be planned to make such inspections or tests easily accessible for accomplishment.

*j. Miscellaneous factors.* Other factors which affect corrosion and require consideration in design are temperature, velocity, chemical concentration, contamination, and absence of film-forming properties in some waters.